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Automatic Defect Detection and Classification in Images of the NIF Large Optic Inspection System.

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We are beginning development of a prototype analysis system for the automated inspection of large laser optics (online). The analysis system, INSPECT, will computationally locate defects and compute several discriminating measurements. These values are to be stored in a database for tracking defects in time.

A digital video camera is used to capture images of a sol-gel AR coated, fused Silica lens, which is roughly 580mm in diameter and 35mm thick in the center. White light is guided into the edges of the optic via a fiber optic illuminator. Defects in the optic scatter this light and form bright spots in the image.

Initial algorithm development has yielded a method for defining the border of the optic in the acquired image. This allows the optic to be isolated from the distracting background, so analyses can be concentrated on the area of interest. Further, the analytic determination of the best-fit circle to the optic gives a reference point (the circle center) for recording defect locations, since there is no fiducial reference for declaring an "origin".

Having isolated the optic in the image, various analysis methods can be employed. Since the optic image is fairly noiseless, edge-detection and high-frequency analyses highlight some defects. We are currently in the process of comparing computer-detected objects with sketches from manual inspection. This will give us an objective measure of the algorithms' performance. The algorithms may be combined or modified in accordance with the findings of this evaluation.

Once defects are located, several pertinent measurements will be computed (this depends on understanding the relationship between the scattered-light signal in the image and the actual dimensions and characteristics of the defect that caused the signal): 1) area of the defect, 2) integrated intensity of the defect and 3) location of the defect. Also, a means must be developed whereby a pixel-to-mm conversion factor can be computed and stored for each image.

The measurements will be stored in a database so that they are always available, independent of the image analysis, and can be analyzed, tracked and deciphered as needed.

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